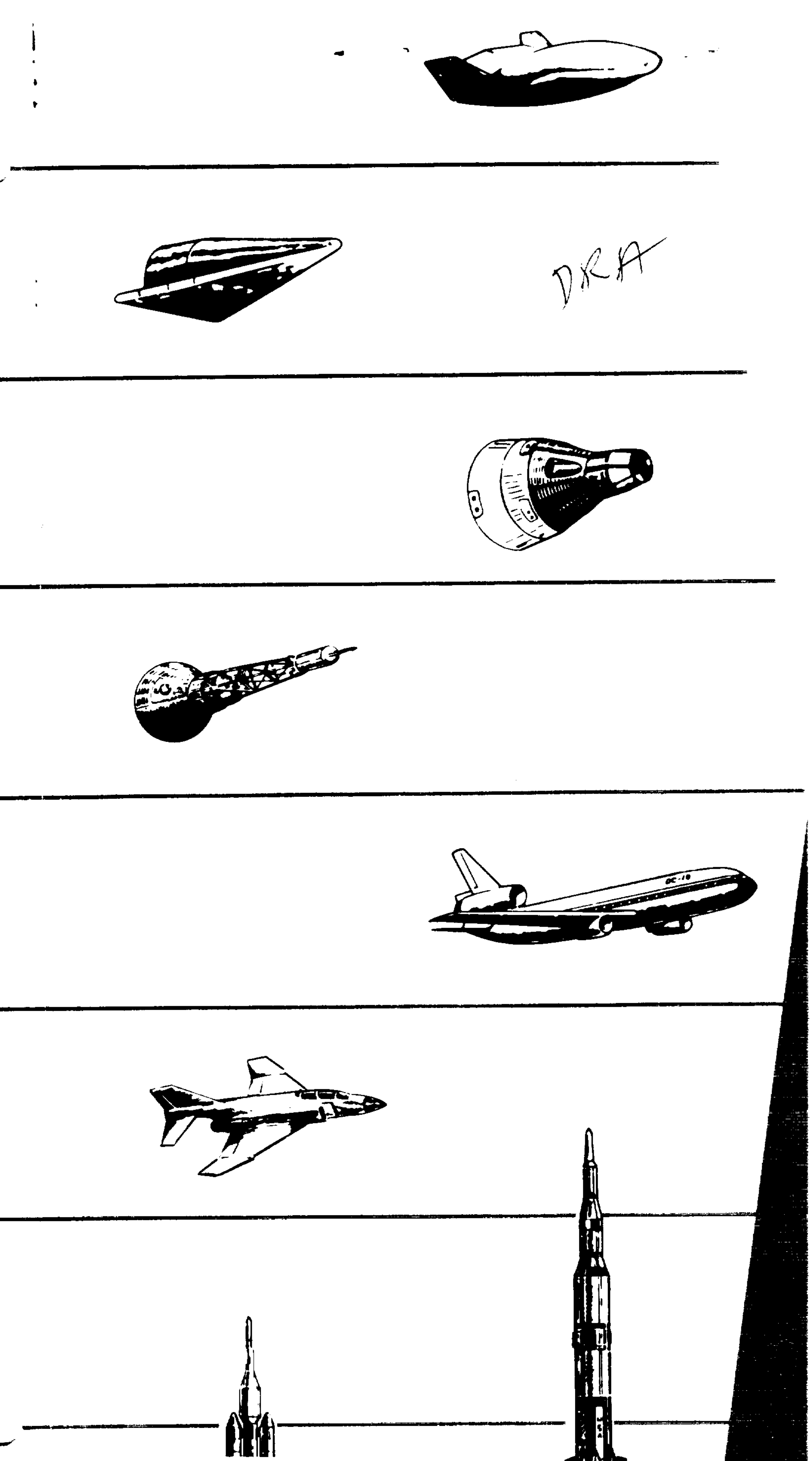

IF255G700

Interface Control Document

ORBITER/PAYLOAD

SPACE SHUTTLE

LOW COST

(NASA-CR-143914) SPACE SHUTTLE SYSTEM: ORBITER/PAYLOAD INTERFACE CONTROL DOCUMENT (McDonnell-Douglas Corp.) 58 p

N75-76055

Unclas

SPECIFICATION NUMBER IF255G700

DATE 30 June 1971

PRELIMINARY

ORBITER/PAYLOAD INTERFACE CONTROL DOCUMENT

FOR THE

SPACE SHUTTLE SYSTEM

PREPARED UNDER CONTRACT
NAS8-26016
FOR

NASA

BY

MCDONNELL DOUGLAS CORPORATION
MARTIN MARIETTA DENVER DIVISION
PAN AM
TRW SYSTEMS GROUP

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1. SCOPE. This document defines the interface requirements between the Space Shuttle Orbiter and the payload to be carried by the Orbiter for Space Shuttle missions. Conformance to the requirements of this Interface Control Document (ICD) will assure compatibility between the Orbiter and the payloads provided by payload contractors. The Space Shuttle System is defined in SS255H001.

2. APPLICABLE DOCUMENTS. The following documents, of exact issue shown, form a part of the specification to the extent specified herein. In the event of conflict between documents referenced herein and other detail content of Sections 3 and 4, the detail requirements of Sections 3 and 4 shall be considered as the superseding requirements.

2.1 Government Documents.

SPECIFICATIONS

NASA

SS255H001	System Specification for the Space Shuttle System

OTHER PUBLICATIONS

NASA

CD255I001	Electromagnetic Interference Control Document for the Space Shuttle System
IF255G800	Space Shuttle/Launch Facility Interface Control Document for the Space Shuttle System

3. INTERFACE REQUIREMENTS

3.1 Physical Interface

3.1.1 Mechanical Interface

3.1.1.1 Payload Bay Envelope. The Orbiter shall provide a payload bay with volume provisions for a payload envelope fifteen (15) feet in diameter and sixty (60) feet in length. Total clearance envelopes are shown in Figure 1. The Orbiter structure or components shall not protrude into the payload clearance envelope except as shown in Figure 2 (TBD) under any design flight loading condition including the effects of loads accelerations, temperatures, pressures and dynamic response. The payload structure and components shall not protrude into the Orbiter clearance envelope except as defined in Figure 3 (TBD) under any quasi steady acceleration condition defined in Figure 4 (TBD) in combination with dynamic response to vibration environments defined in Figure 5 (TBD) together with effects of temperatures and internal or external pressures.

3.1.1.2 Payload Mechanical Attachment. The interface for payload mechanical attachment shall be shown in Figure 6 for structural support of all payloads. The Orbiter support fittings shall be capable of being latched and released manually and by remote control by the Orbiter crew.

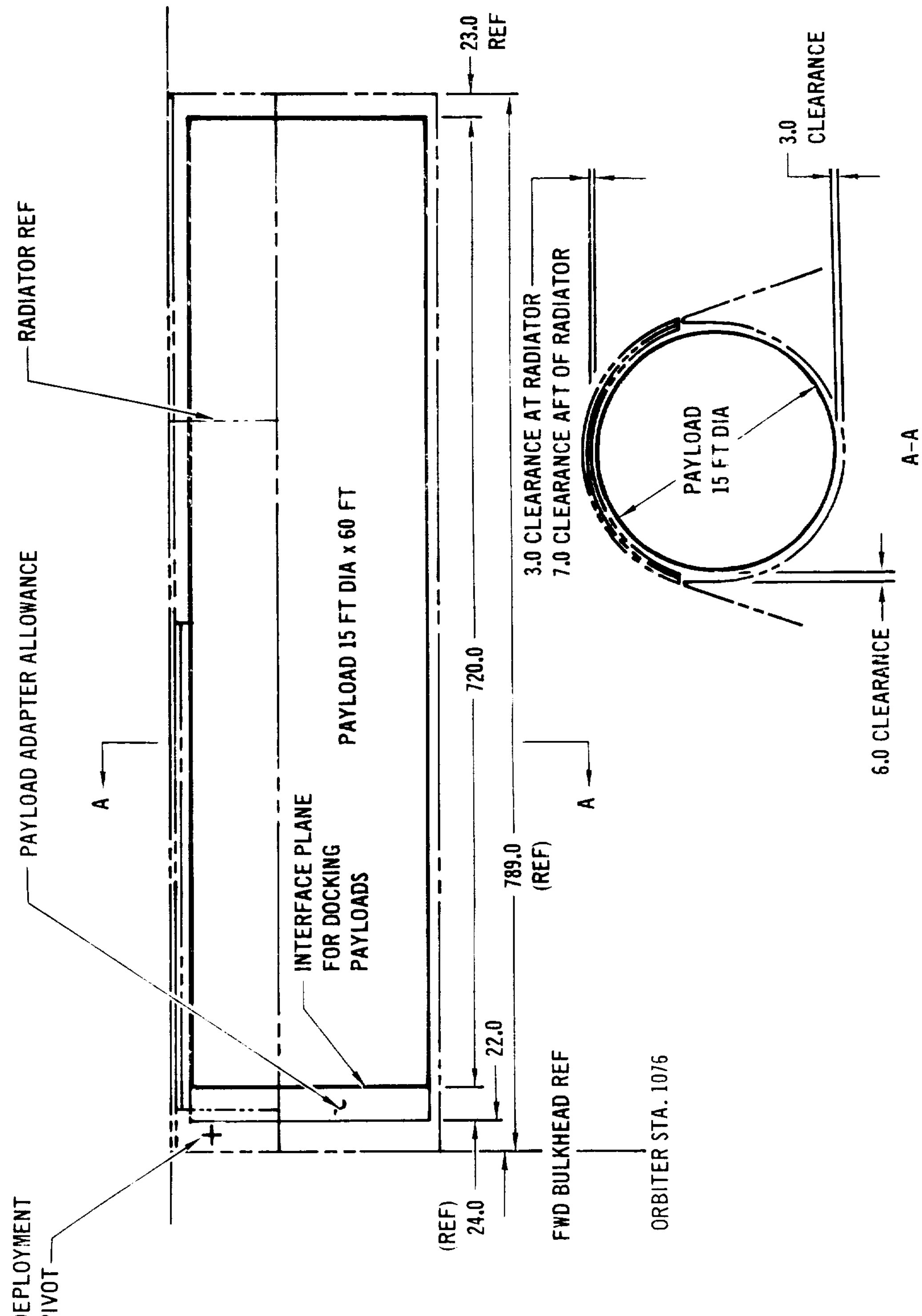


FIGURE 1 PAYLOAD BAY ENVELOPE

(TBD)

FIGURE 2 ORBITER PROTRUSION INTO PAYLOAD ENVELOPE

(TBD)

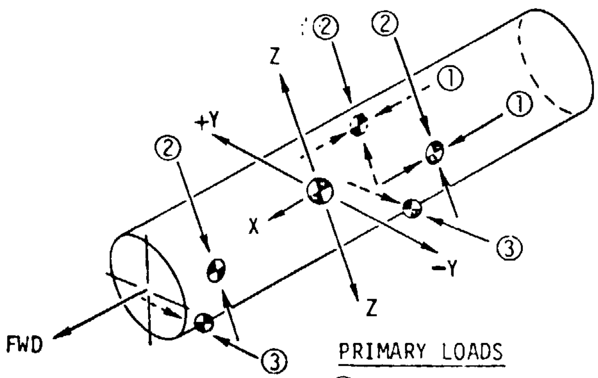
FIGURE 3 PAYLOAD PROTRUSION INTO ORBITER ENVELOPE

(TBD)

FIGURE 4 QUASI-STEADY LOAD CONDITIONS

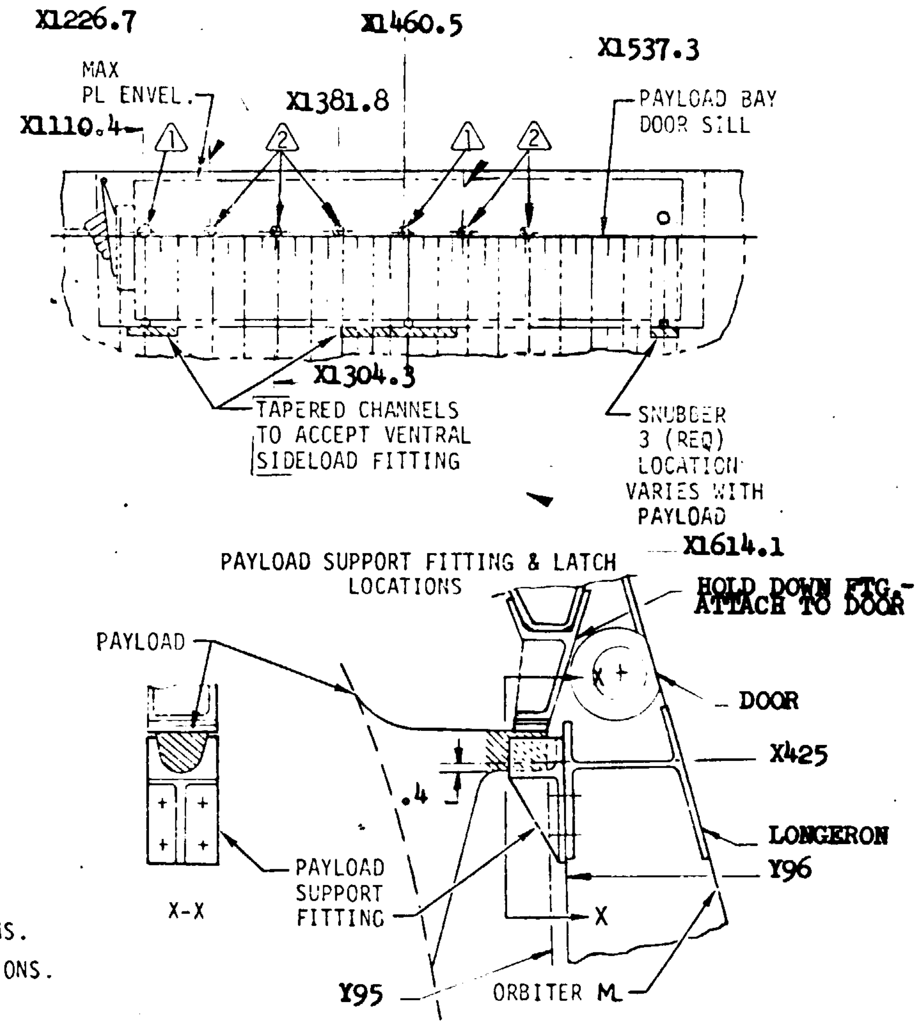
(TBD)

FIGURE 5 VIBRATION ENVIRONMENTS



PRIMARY LOADS

1. FORE AND AFT LOADS TIE DOWN POINTS.
2. UP AND DOWN TIE DOWN POINTS.
3. SIDELOADS TIE POINTS.
4. FREE MOVEMENT PROVIDED:
   a) FOR SIDELOADS IN DOOR SILL FITTINGS
   b) FOR FORE AND AFT AND UP AND DOWN LOADS IN THE VENTRAL FITTINGS
   c) FOR FORE AND AFT LOADS AND SIDELOADS IN THE FORWARD DOOR SILL FITTING.



NOTES:

1. NOMINAL 5 POINT SUPPORT LOCATIONS.
2. ALTERNATE SUPPORT FITTING LOCATIONS.
3. NORMAL RELEASE LATCH SYSTEM REMOTELY OPERATED FROM ORBITER.
4. BACKUP RELEASE LATCH SYSTEM MANUAL FROM ORBITER.
5. SNUBBERS STABILIZE AFT END OF PAYLOAD BUT DO NOT RESIST DEPLOYMENT.

FIGURE 6 PAYLOAD MECHANICAL ATTACHMENT

3.1.1.2.1 Deployment/Docking Mechanism. Deployable payloads shall mate with the Orbiter deployment/docking mechanism as shown in Figure 7.

3.1.1.2.2 Fixed Payload Alignment. The Orbiter payload support fittings shown in Figure 6 shall be referenced to the Orbiter axes as shown in Figure 8 (TBD). The payload shall provide mechanical alignment of fixed payloads to the Orbiter reference axis system to the accuracy required by the payload. The Orbiter shall provide a 180° field-of-view for fixed mounted payloads as shown in Figure 9. The payload shall provide deployable targets or other means, when required, for in-orbit determination of alignment errors.

3.1.1.3 Payload Access.

3.1.1.3.1 Prelaunch Access. The Orbiter shall provide access to the payload bay as shown in Figure 1 for payload installation and removal. Payload access shall also be available through the crew hatch.

3.1.1.3.2 Service Access. Access doors shall be provided by the Orbiter as shown in Figure 10 for service access to the payload.

3.1.1.3.3 On-Orbit Access. The Orbiter shall provide a flexible tunnel for pressurized access to a deployed payload module. The tunnel shall allow 90 degree rotation of the payload to

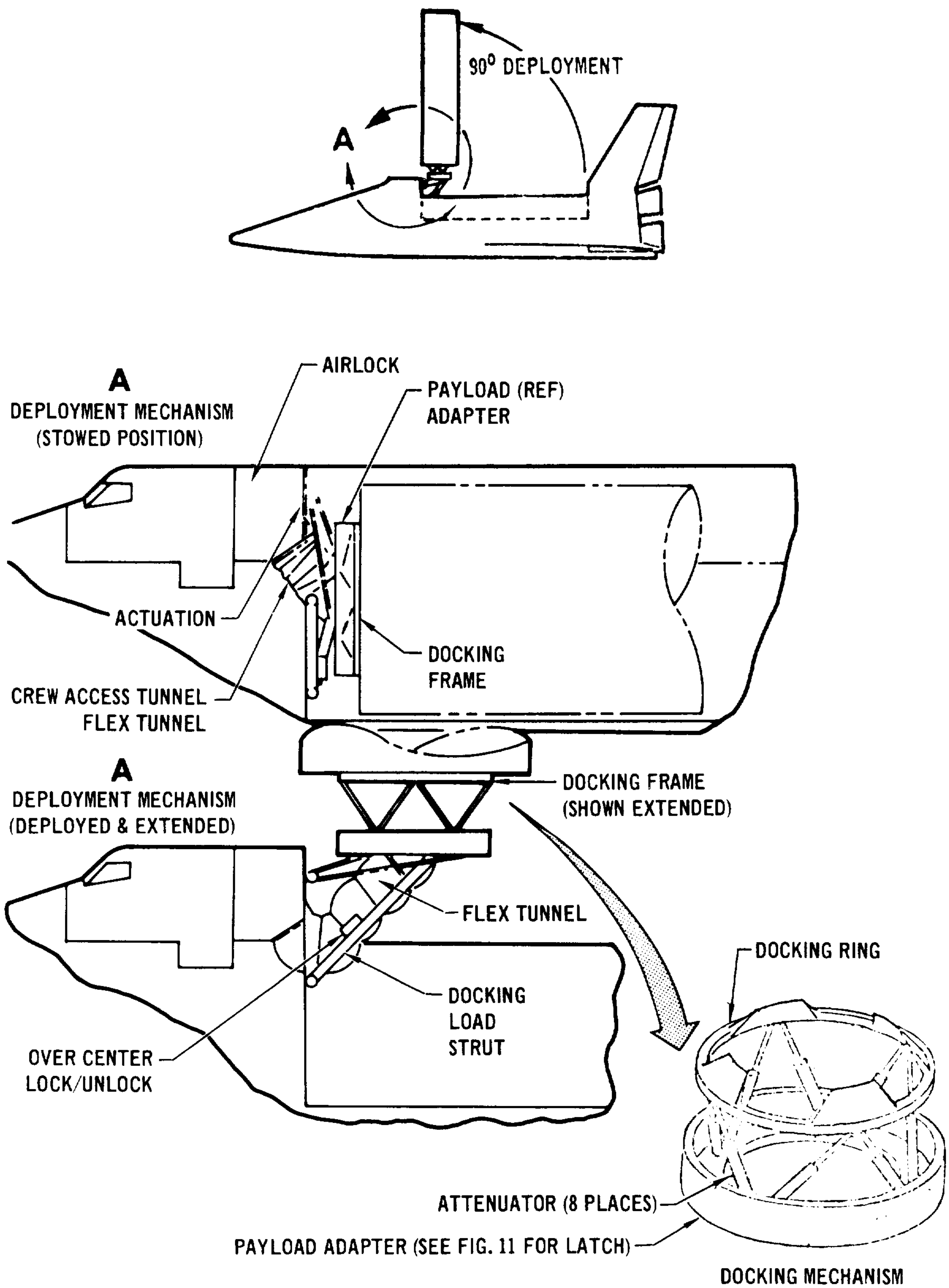
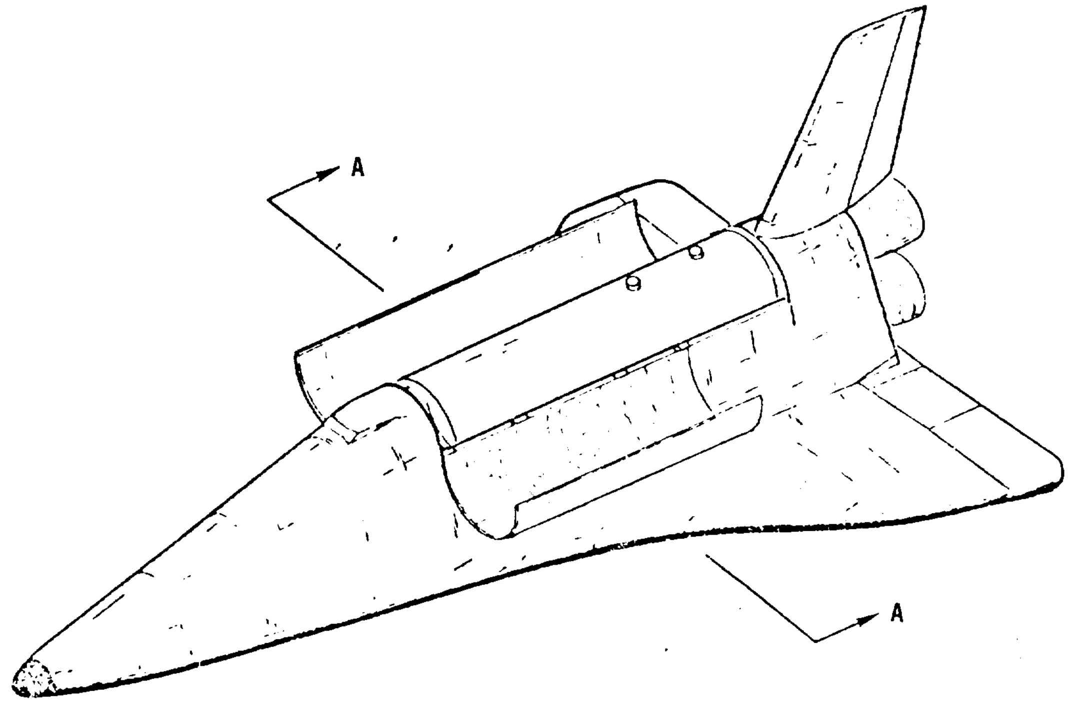


FIGURE 7 DEPLOYMENT/DOCKING MECHANISM

(TBD)

FIGURE 8 SUPPORT FITTING REFERENCE TO ORBITER AXES



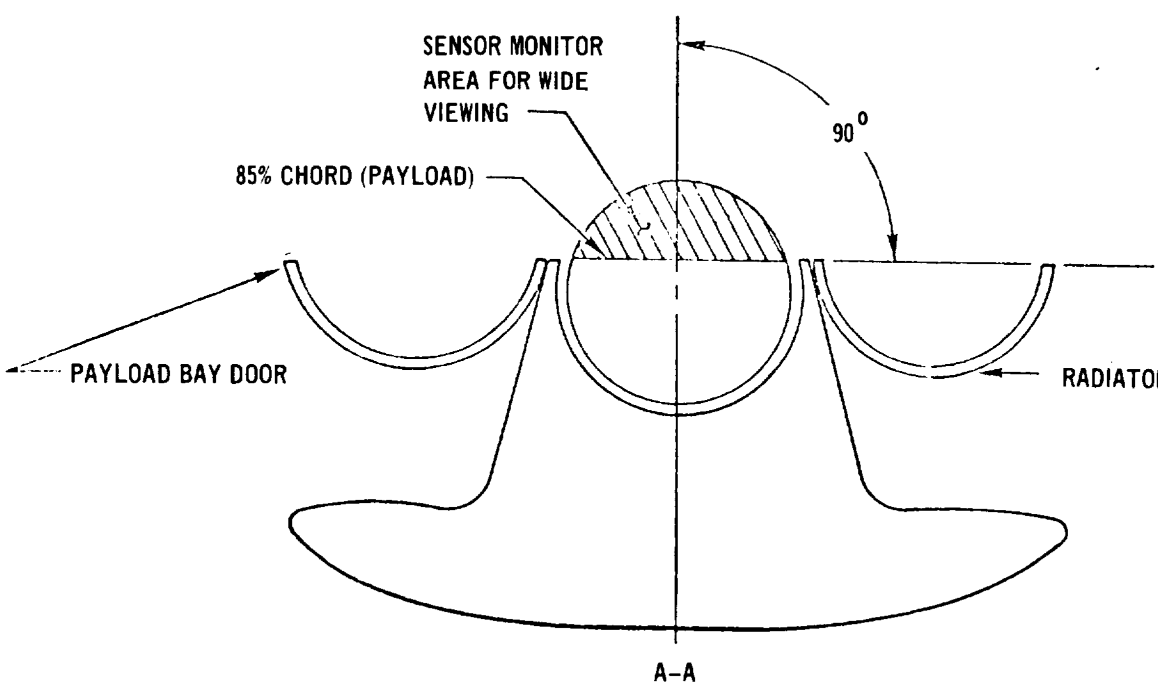


FIGURE 9 FIXED PAYLOAD FIELD–OF–VIEW

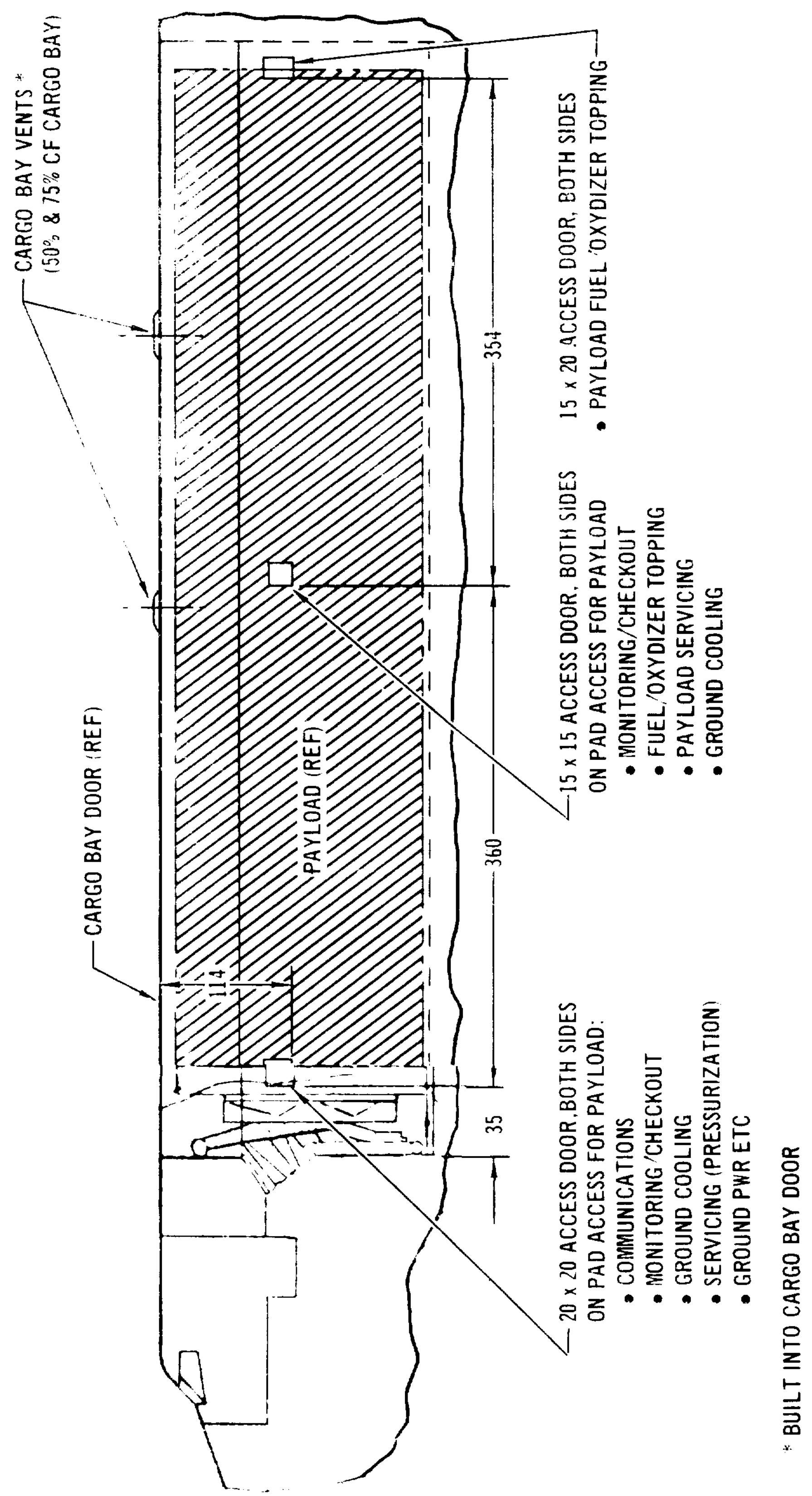


FIGURE 10 SERVICE ACCESS

the deployed position. The tunnel and payload module shall mate as shown in Figure 11.

3.1.1.4 Payload Mass Properties. The total payload weight and center-of-gravity location shall conform to the requirements shown in Figure 12 (TBD). The total payload weight shall include the weight of the payload modules, pallets (fixtures), EVA provisions, passengers, removable provisions for passengers, and all special equipment required to support, transfer, manipulate or deploy the payload.

3.1.1.5 Payload Bay Provisions. Provisions for purging and venting the payload bay for all mission phases shall be provided by the Orbiter to fulfill the requirements specified in Table I (TBD).

3.1.1.6 Payload Deployment. The Orbiter shall have the capability to deploy and release the payload on-orbit.

The Orbiter payload deployment/docking mechanism shall extend the payload from the bay as shown in Figure 7 at a rate of TBD degrees per second.

The Orbiter shall be capable of releasing the payloads from the mechanism and separating from the payload without imparting angular rates greater than TBD* upon the payload.

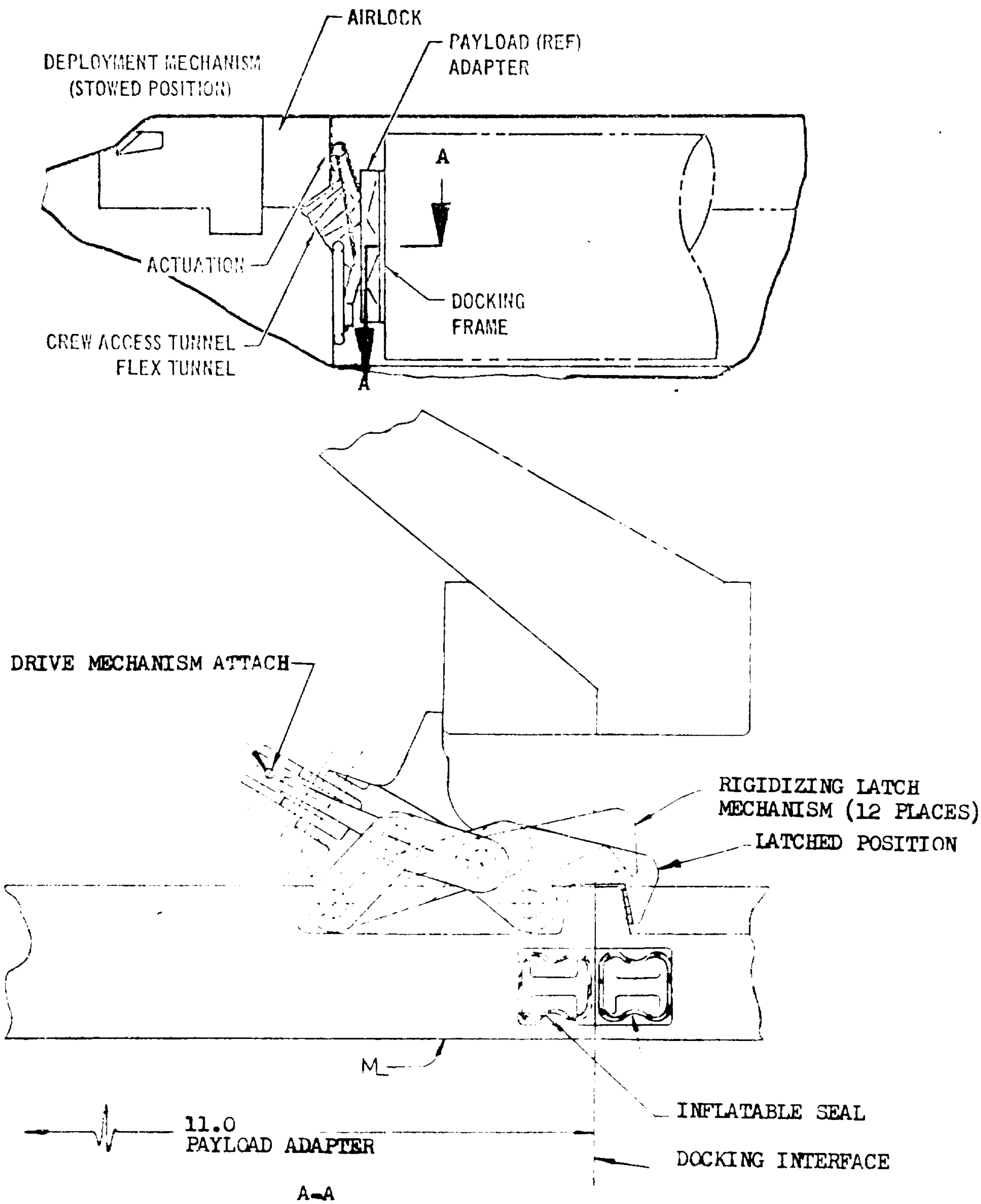


FIGURE 11 TRANSFER TUNNEL/PALOAD INTERFACE

(TBD)

FIGURE 12 PAYLOAD WEIGHT AND CENTER-OF-GRAVITY REQUIREMENTS

(TBD)

FIGURE 12 PAYLOAD WEIGHT AND CENTER-OF-GRAVITY REQUIREMENTS (Continued)

(TBD)

TABLE I PAYLOAD BAY PURGE AND VENT REQUIREMENTS

3.1.1.7 Payload Retrieval. The Orbiter shall utilize the deployment/docking mechanism shown in Figure 7 to retrieve payloads.

The mechanism shall be capable of retrieval and stowage of retrievable payload modules in the reverse order of the deployment sequence.

3.1.1.8 Payload Docking. The Orbiter shall have the capability of docking to stabilized modules with subsequent retrieval handling and stowage for orbit transfer or return to Earth.

During the terminal docking sequence, the Orbiter shall control the payload module to the parameters specified in Table II.

The Orbiter shall provide the field-of-view shown in Figure 13 for visual alignment of the payload during docking operations.

3.1.2 Physical Electrical Interface. The physical electrical interface for electrical power and avionics shall be as shown in Figures 14 (TBD) and 15 (TBD), respectively.

3.1.2.1 Controls And Displays Physical Interface. The physical interface for payload controls, displays and other equipment which are a part of the payload but mounted within the pressurized Orbiter crew station shall be as shown in Figure 16 (TBD).

TABLE II - PAYLOAD DOCKING PARAMETERS

PARAMETER	MAXIMUM VALUE	
MISS DISTANCE	6.0	INCHES
LONGITUDINAL VELOCITY*	0.4	FEET PER SECOND
LATERAL VELOCITY*	0.15	FEET PER SECOND
MISS ANGLE	3.0	DEGREES
ANGULAR RATE	0.1	DEGREES PER SECOND

* REFERS TO RELATIVE VELOCITY PAYLOAD MODULE TIP RELATIVE TO DOCKING PORT.

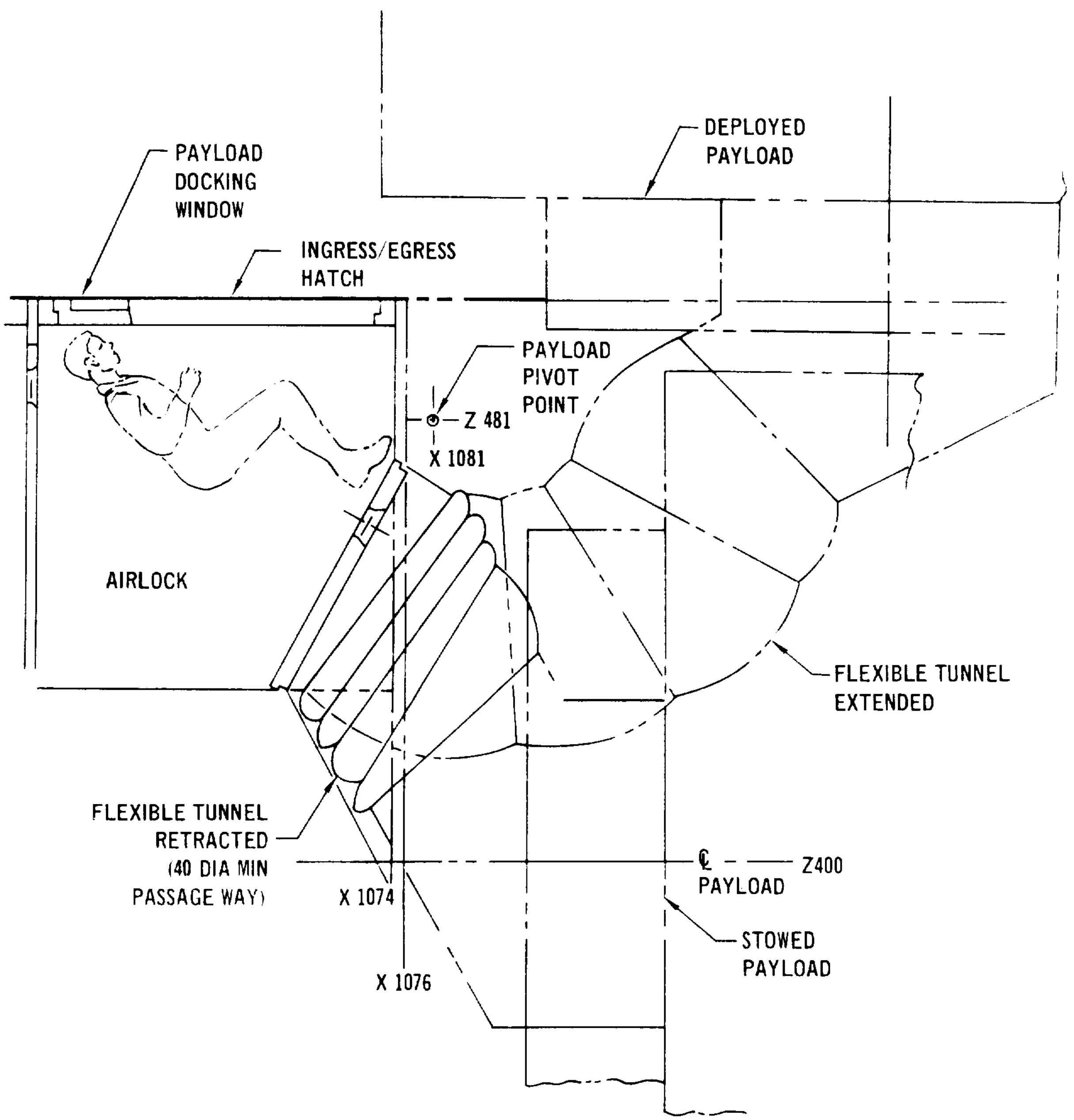


FIGURE 13 PAYLOAD DOCKING

(TBD)

FIGURE 14 ELECTRICAL POWER PHYSICAL INTERFACE

(TBD)

FIGURE 15 AVIONICS PHYSICAL INTERFACE

(TBD)

FIGURE 16 CONTROLS AND DISPLAYS PHYSICAL INTERFACE

3.1.3 Fluid Interface.

3.1.3.1 Payload Propellant Loading. The Orbiter shall provide access ports, as shown in Figure 10, to facilitate payload propellant loading or topping operations.

3.1.3.2 Payload Propellant Venting. The provisions provided by the Orbiter for venting payload propellants shall be as shown in Figure 17.

3.1.4 Pneumatic Interface.

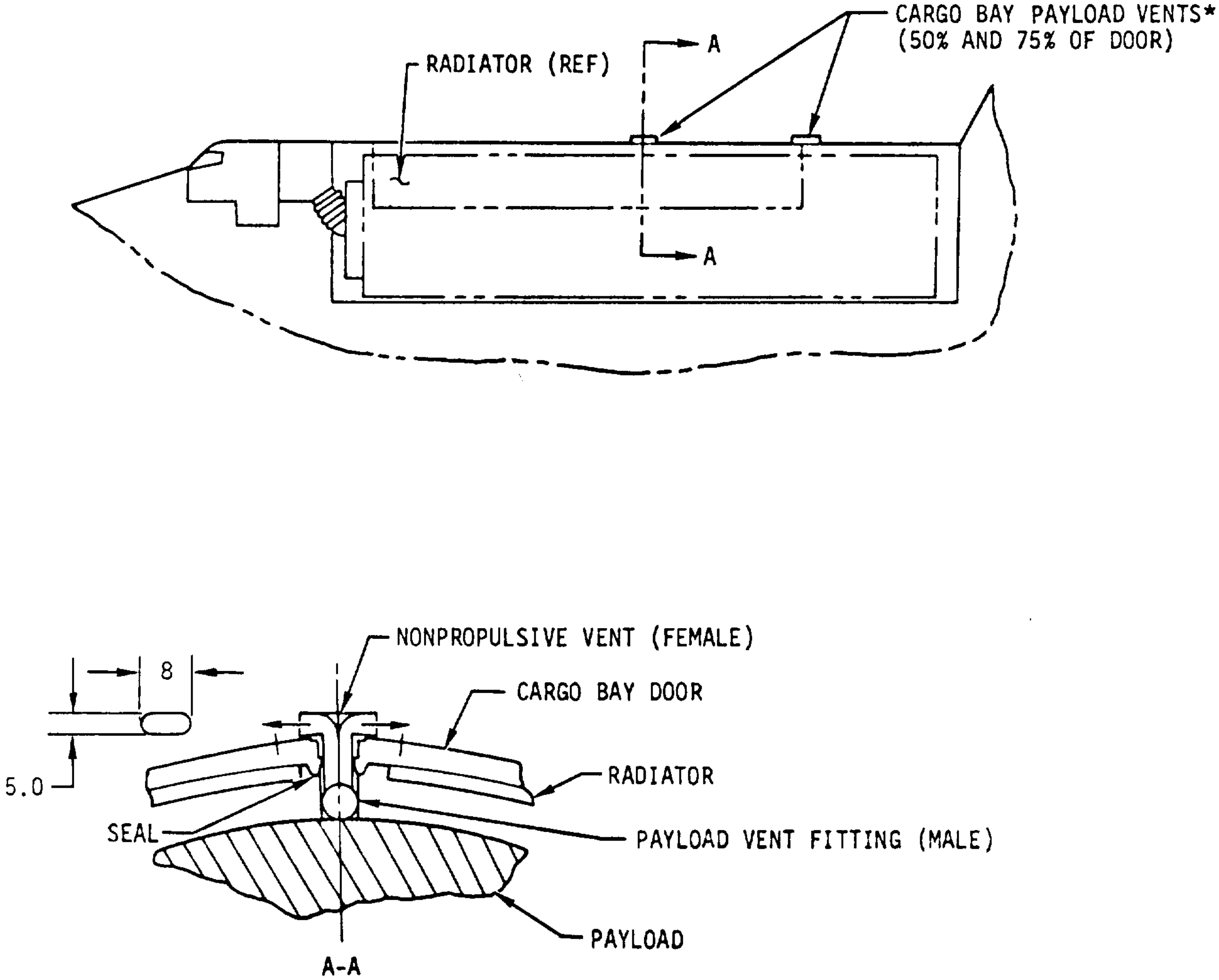
3.1.4.1 Crew Tunnel. The crew tunnel pneumatic interface shall be as shown in Figure 18 (TBD).

3.1.4.2 Effluent Vents. The interface for venting effluents from the payload shall be as shown in Figure 17.

3.2 Functional Interface.

3.2.1 Structural Loads. The payload shall withstand the Orbiter design limit quasi-steady accelerations shown in Table III (TBD) and dynamic environments shown in Table IV (TBD) without exceeding the limit attachment point loads shown in Table V (TBD).

3.2.2 Electrical Power.



* BUILT INTO CARGO BAY DOOR

FIGURE 17 PAYLOAD PROPELLANT AND EFFLUENT VENTS

(TBD)

FIGURE 18 CREW TUNNEL/PAYLOAD PNEUMATIC INTERFACE

TABLE III ORBITER DESIGN LIMIT QUASI-STEADY ACCELERATIONS

(TBD)

TABLE IV DYNAMIC ENVIRONMENTS

(TBD)

TABLE V LIMIT ATTACH POINT LOADS

(TBD)

3.2.2.1 Power Supply. The Orbiter shall supply a maximum of 20 kilowatt-hours of electrical energy to the payload bay junction box connectors in the form of direct current at an unregulated 120 volt ±10% potential. The electrical power functional interface shall be as specified in Table VI (TBD).

The payload power requirements shall be limited to 500 watts average and 800 watts peak, including all transients.

The payload shall supply the electrical power required by the payload during all ground operations including the launch phase.

3.2.3 Avionics. The data transmission, command, display and control, checkout, data bus, guidance and navigation, and status monitoring services for the payload shall be as specified in Tables VII, and VIII. Provisions for securing data and communications shall be payload-supplied.

3.2.3.1 Data Management.

3.2.3.1.1 Data Management Capacities. The Orbiter data management and data bus system shall be capable of providing the following for payload use during shuttle critical flight phases such as launch, entry, and landing:

TABLE VI ELECTRICAL POWER FUNCTIONAL INTERFACE

(TBD)

TABLE VII PAYLOAD MESSAGES TO THE ORBITER

(TBD)

TABLE VIII ORBITER MESSAGES TO THE PAYLOAD

(TBD)

A. 2,000-word memory, 32 bits/word

B. 5,000 computer operations/second

C. 5 KBPS data bus capacity

D. 1 megabit bulk storage memory

During Orbiter quiescent time periods the Orbiter data management and data bus system shall be capable of providing the following for payload use:

A. 2,000-word memory, 32 bits/word

B. 10,000 computer operations/second

C. 50 KBPS data bus capacity

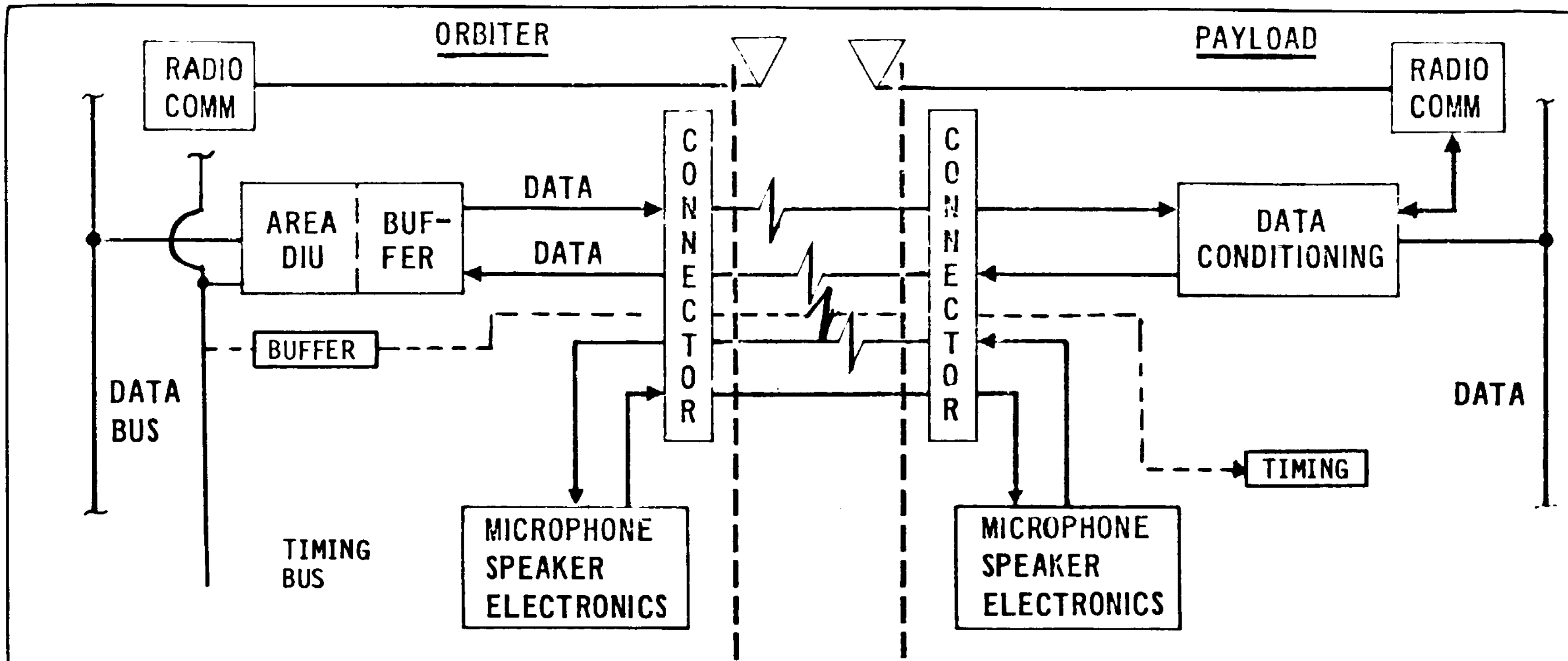
D. 1 megabit bulk storage memory

Time per computer operation is 2 μsec - equivalent to one "add" time.

3.2.3.1.2 Data Bus Transmission Lines. Three identical number TBD twisted shielded pair transmission lines (two for data lines and one for a clock line), as shown in Figure 19 shall constitute a single data bus interface between the Orbiter and payload. (Four interfaces are used for redundancy.)

3.2.3.1.3 Data Bus Type. The data transmitted between the payload and Orbiter, via the simplex data bus, shall be digital with a word serial, bit serial, time division multiplex (TDM) format.

3.2.3.1.4 Data Bus Rate. The digital bit rate of the data bus shall be 1000 KBPS ± 1.0 percent. The sample or data bus



NOTES:

- SINGLE PATH SHOWN: 4 PATHS TOTAL
- REDUNDANT PATHS (3) ARE INDENTICAL
- TWISTED SHIELDED PAIR WIRING

COMMUNICATIONS:

- DUPLEX VOICE OPERATION HARDWIRED
- RF UHF; VOICE AND DATA FOR FREE FLIGHT ORBITAL OPERATIONS

DATA:

- CAUTION/WARNING PARAMETERS
- ABORT/SEPARATION SIGNALS
- ASYNCHRONOUS BUS OPERATION
- DIU HAS LIMITED INTERFACE DATA STORAGE
- SIMULTANEOUS TRANSMISSION OVER SEPARATE WIRES
- GUIDANCE AND NAVIGATION (ATTITUDE, POSITION TARGET ACQ)
- DISPLAY AND CONTROL
- CHECKOUT

FIGURE 19 BASIC AVIONICS INTERFACE

transfer rate available for any given parameter shall be one to 50 samples (32 bit words) per second.

3.2.3.1.5 Data Bus Message Format. The data line message shall consist of a number of 9-bit bytes (8 information bits and 1 parity bit). The interface message format shall be as shown in Figure 20. The Orbiter computer-to-payload digital interface unit (DIU) message shall contain a 6-bit code for addressing up to 64 DIU's and a 10-bit function code defining the following: Internal DIU channel to be selected; code bits specifying whether the message is a command, data, or command-data combination request; and the message length (i.e., the number of information bytes to follow). There shall be a maximum of 7 information bytes. Each message shall be concluded with a vertical parity byte. The DIU address and function code shall be the equivalent of two bytes. Therefore, the maximum number of bytes in a computer to DIU message shall be 10 (90 bits).

Payload DIU-to-Orbiter computer messages shall consist of 1 to 34 bytes. The first byte shall always be the address of the responding DIU. (This will acknowledge the receipt of messages from the computer). The last byte shall be vertical parity (not sent unless data bytes are used). The intermediate bytes shall be information bytes varying between zero and 32 in number. The maximum number of bytes in each DIU-to-computer message shall be 34 (306 bits).

ORBITER TO PAYLOAD

DIU ADDRESS & FUNCTION CODE		INFORMATION	VERTICAL PARITY
1 BYTE	1 BYTE	0 ⟶ 7 BYTES	1 BYTE

PAYLOAD TO ORBITER

DIU ADDRESS	INFORMATION	VERTICAL PARITY
1 BYTE	0 ⟶ 32 BYTES	1 BYTE

FIGURE 20 MESSAGE FORMAT

The data line shall carry bipolar differential signals which are bi-phase level coded and smoothed. The harmonic content above 2.5 MHz shall be at least 24 db (referenced to the peak amplitude of the signal). A logical "one" (data bit one) shall be transmitted as a coded bipolar 1, 0 signal which is in phase with the reference clock signal. A logical "zero" (data bit zero) shall be transmitted as a coded bipolar 0, 1 signal which is 180 degrees out-of-phase with the reference clock signal. No signals shall be generated on the data line during the interval between words (no-data periods).

The clock line shall carry a 1000 KBPS ± 1.0 percent clock reference signal from the Orbiter computer to all terminals on the bus. The clock signal shall be a bipolar differential sinusoidal signal. The positive going zero crossing shall define the start of the clock period. Short-term variation, i.e., cycle-to-cycle variation in clock period, shall not exceed 5 ± 0.5 nanoseconds.

Data bus coding at the interface shall be of standard PCM format with the least significant bit (LSB) received first at the interface. The address and function codes shall be as defined in Tables VII and VIII.

3.2.3.1.6 Data Bus Impedance. The impedance looking into the Orbiter from the interface shall be greater than 10,000 ohms essentially resistive when the Orbiter is in the receiving data mode, and shall be 72 ohms ± 1.0 percent when the Orbiter is transmitting data. The impedance looking into the payload from the interface shall be greater than 10,000 ohms essentially resistive when the payload is in the receiving data mode, and shall be 72 ohms ± 1.0 percent when the payload is transmitting data.

3.2.3.1.7 Data Bus Voltages. All payload and Orbiter signal voltages for data bus transmittal shall be in the range of ± 1.0 volt to ± 7.0 volts peak line-to-ground.

3.2.3.1.8 Data Bus Signal-to-Noise Ratio. All payload and Orbiter signals for data bus transmittal shall have a signal plus noise-to-noise ratio of TBD db at the interface.

3.2.3.2 Data Correlation And Initialization. The Orbiter shall be capable of providing the following information to the payload via the data bus for data correlation and initialization.

A. Orbiter attitude, Orbiter attitude rate, and Orbiter position

B. Greenwich mean time and means of synchronizing the payload systems with the Orbiter computer clock.

3.2.3.3 Controls And Displays. During Orbiter critical flight operating phases (launch, entry and landing), only payload-generated signals concerning abort and safety shall be displayed in the

Orbiter. During non-critical flight phases and as commanded by the crew, the Orbiter shall be capable of selecting and displaying payload signals to provide payload control or payload health data. Table VII specifies the signals to be provided by the payload and displayed by the Orbiter. Table VIII specifies the signals to be provided by the Orbiter and displayed by the payload.

3.2.3.4 Onboard Checkout. As commanded by the crew, the Orbiter shall be capable of sending the checkout commands specified in Table VIII to the payload. Payload response to these commands shall be as specified in Table VII.

3.2.3.5 Caution And Warning. The Orbiter shall display payload caution and warning conditions upon receipt of the payload-generated caution and warning signals identified in Table VII. The payload module, for passenger-carrying missions, shall display Orbiter caution and warning conditions upon receipt of the Orbiter-generated caution and warning signals identified in Table VIII.

3.2.3.6 Communications.

3.2.3.6.1 Radio Frequency Interfaces. Radio frequency (RF) interfaces shall meet the following requirements:

A. RF Range - The Orbiter shall transmit with an effective radiated power of 10 watts and provide a receiver sensitivity of TBD dbm at a TBD signal-to-noise ratio. The payload shall transmit with an effective radiated power of TBD watts and provide a receiver sensitivity of TBD dbm at a TBD signal-to-noise ratio. The Orbiter shall operate in S-band and provide an operating range of 250 nautical miles.

B. RF Downlink - The Orbiter RF downlink system shall have provisions for handling up to 5 KBPS of payload-generated data in addition to the normal Orbiter-generated data. The payload data shall be formated in digital form compatible with the Orbiter data bus system as specified herein. The payload and Orbiter downlink data shall be merged within the Orbiter and transmitted via the Orbiter RF transmission system. Provisions for secure data and communication systems shall be payload-supplied.

C. Antenna Characteristics - Orbiter S-band antenna pattern characteristics shall be as shown in Figure 21 (TBD). The Orbiter S-band antenna gain shall be greater than 0 db over 80 percent of the total sphere. Payload S-band antenna pattern characteristics shall be as shown in Figure 22 (TBD). The payload S-band antenna gain shall be greater than 0 db over TBD% of the total sphere.

D. RF Electronics Characteristics - The RF interface

(TBD)

FIGURE 21 ORBITER S-BAND ANTENNA CHARACTERISTICS

(TBD)

FIGURE 22 PAYLOAD S-BAND ANTENNA CHARACTERISTICS

characteristics shall be as specified in Figure 23 (TBD).

The voice signal generated in the payload and Orbiter for RF transmission to the other vehicle shall meet the voice signal characteristics specified for hardwire voice communication interfaces in subsequent paragraphs.

The Orbiter RF transceiver system shall be capable of receiving 1 KBPS of digital data generated within and transmitted from a free-flying payload. Payload data transmitted via RF to the Orbiter shall meet the requirements specified in Figure 23.

The Orbiter shall have the capability for transmission of 1 KBPS commands for Orbiter control of the payload. Also, the Orbiter RF uplink (from ground) shall be capable of receiving up to 100 BPS digital command signals destined for the payload, in addition to the normal Orbiter RF uplink command signals. The modes of transferring both of these commands from the Orbiter to payload shall be hardwire (e.g., via Orbiter data bus) when the payload is attached to the Orbiter and RF when the payload is deployed (released). RF commands from the Orbiter to payload shall have a data format described in Figure 24 (TBD). Command

	ORBITER	PAYLOAD
Transmitter RF Power	12 watts S-band 10 watts (225-400 MH_z)	TBD
Modulation	S-Band o PSK o TRANSMIT 70KH_z FM data subcarrier 30KH_z FM voice subcarrier Baseland ranging signal o RECEIVE 1.024 MH_z PM data subcarrier 1.25 MH_z FM voice subcarrier UHF o Double sideband AM	Compatible with Orbiter (TBD)
Range	Voice: 250 N.M. Data: 250 N.M. Ranging: 400 N.M.	TBD
Frequency	S-Band o Transmit 10 channels in 1.75 to 1.85 GH_z band 10 channels in 2.02 to 2.12 GH_z band o Receive 10 channels in 2.2 to 2.3 GH_z band UHF o 3500 channels in 225 to 400 MH_z band	TBD
Percent Modulation or modulation induces	TBD	TBD
Information noise bandwidth	TBD	TBD
Required signal to noise ratios	TBD	TBD
Required signal to noise margin	TBD	TBD

FIGURE 23 RF INTERFACE CHARACTERISTICS

(TBD)

FIGURE 24 ORBITER RF COMMANDS TO PAYLOAD equipment shall be supplied by the payload contractor when additional command capability is required.

3.2.3.6.2 Hardwire Communication Interfaces.

3.2.3.6.2.1 Voice Interfaces. The interface shall have provisions for two-way transfer of voice data via hardwire when the payload is in the Orbiter cargo hold and via RF when the payload is free-flying (See RF Interfaces.).

3.2.3.6.2.2 Voice Transmission Lines. Four voice transfer and control interfaces shall be provided between the Orbiter and the payload. Each interface shall allow: Two-way voice transfer, push-to-talk control of the Orbiter transceivers from the payload, and a two-way command call between the Orbiter and payload. The command call interface allows the payload to override sleep switches or other voice broadcast cutoff switches within the Orbiter and conversely, allows the Orbiter to override sleep switches or other voice broadcast cutoff switches within the payload.

3.2.3.6.2.3 Type of Voice Interface Lines. Two number TBD twisted shielded pair transmission lines constitute one two-way voice transfer circuit between the Orbiter and payload. The payload and Orbiter push-to-talk controls and command call signals shall use the Orbiter data bus for command transfer within the Orbiter.

3.2.3.6.2.4 Voice Transfer Circuit Impedance. The signal source (microphone) impedance on the Orbiter and payload sides of the voice transfer circuit interface shall be 600 ± TBD ohms when operating. Also, the destination or load (speaker) impedance on the Orbiter and payload sides of the voice transfer circuit interface shall be 600 ± TBD ohms when operating. These interface impedance requirements shall be met over the frequency range of 300 Hz to 3 KHz.

3.2.3.6.2.5 Voice Transfer Circuit Frequency Response. The frequency response of the voice signals across the interface shall be within ±4 db referenced to 1000 Hz over the frequency range of 300 Hz to 3000 Hz.

3.2.3.6.2.6 Voice Transfer Circuit Signal Levels. The payload-to-Orbiter and Orbiter-to-payload voice signal levels shall be 0 dbm ± 13 dbm at the interface over all ranges of allowable source and load impedances.

3.2.3.7 Guidance And Navigation.

3.2.3.7.1 Attitude Control. The Orbiter attitude control system shall be capable of providing local vertical pointing (NADIR) of the open cargo bay, continuously for a complete orbit.

Tracking, fine pointing, and specific target acquisition shall be provided by payload systems. The Orbiter attitude control system shall be capable of providing the following orientation of the cargo bay:

NADIR $\pm 45°$ with an accuracy of $\pm 1°$ and stability of 0.3 deg/sec.

The Orbiter attitude control system shall not constrain the ability to orient and point the payload at the Earth or any celestial object.

3.2.4 Fluid Interface.

3.2.4.1 Pressures And Flow Rates. The payload shall control fluid pressures and flow rates at the fluid interfaces to the values specified in Table IX.

3.2.5 Electromagnetic Compatibility. The Orbiter and payload shall each be designed to meet the requirements of CD255I001.

3.2.6 Environmental Interface. The Orbiter payload bay environment shall not exceed the values shown in Table X for the designated mission phases based upon the specified payload.

Payloads which cannot withstand the designated environments shall provide the necessary equipment to control the environment to an acceptable level. The additional equipment, such as vibration isolation and load attenuation apparatus, shall be charged as part of the payload.

The payload bay shall be vented by the Orbiter during launch and shall be unpressurized during the orbital phase.

TABLE IX PAYLOAD FLUID PRESSURES AND FLOW RATES

(TBD)

TABLE X PAYLOAD ENVIRONMENT

(TBD)

3.3 Procedural Interface.

3.3.1 Prelaunch. All payloads shall be premounted on a standard pallet or fixture and checkout completed prior to installation into the Orbiter. Equipment for ground checkout and control of the payload during the prelaunch and launch phases shall be provided by the payload contractor.

The payload shall nominally be loaded and off-loaded with the Orbiter in a horizontal position prior to Booster mating. Orbiter and payload design, however, shall not preclude payload access, loading or off-loading with the Orbiter in a vertical position.

3.3.2 Launch. On-pad access to the payload shall be limited to the doors shown in Figure 6 and to those locations accessible from the crew hatch.

3.3.3 Ascent. The docking mechanism shall not be attached to the payload during ascent.

3.3.4 On-Orbit.

3.3.4.1 Duty Cycles. Payload operations shall assume a minimum of one passenger available throughout a 24-hour period, in 6-hour duty cycles.

3.3.4.2 Cargo Transfer. The Orbiter shall provide for limited transfer of cargo through the personnel transfer hatch. Personnel and cargo transfer operations should nominally be accomplished in a single intra-vehicular operation.

3.3.4.3 In-Orbit Maintenance. In-orbit maintenance and repair of payload components shall be accomplished by payload-supplied modular part replacement.

3.3.5 Entry. (TBD)

3.3.6 Transition. (TBD)

3.3.7 Landing. (TBD)

3.4 Safety.

3.4.1 Passenger Emergency Egress. The Orbiter/payload interface shall permit passenger emergency egress compatible with the Space Shuttle/Launch Facility interface specified in IF255G800.

3.4.2 Hazardous Material. Payload elements containing hazardous material shall have self-contained protective devices or provisions against all hazards.

4. VERIFICATION. (TBD)

5. PREPARATION FOR DELIVERY. Not applicable.

6. NOTES.

6.1 Definitions

TBD - To Be Determined. Requirements identified with TBD will be determined during Phase C.